WHAT IS CLAIMED IS:

1. A method for locating an object relative to an array of magnetic sensors in an environment in which there is present a noise signal having a fundamental frequency f_{NOISE}, the method comprising:

generating one or more magnetic signals by means of one or more magnetic emitters mounted at known locations on the object, the one or more magnetic signals having one or more frequencies;

during an integration time T, detecting the one or more magnetic signals and the noise signal at six or more magnetic detectors; and,

determining relative amplitudes of the magnetic signals; wherein the one or more frequencies of the magnetic signals are substantially equal to frequencies at which a power spectrum of the detected noise signal has zeros.

2. A method according to claim 1 wherein the integration time T is equal to N_1/f_{NOISE} , where N_1 is an integer and $N_1 \geq 2$.

3. A method according to claim 2 wherein the one or more frequencies of the magnetic signals are substantially equal to N_2/T where N_2 is an integer which is not an integer multiple of N_1.

4. A method according to claim 1 wherein detecting the magnetic signal comprises:

sampling outputs of the six or more magnetic detectors to provide corresponding sequences of samples and, for each of the one or more magnetic detectors;

multiplying each of the samples by a function which varies periodically at a frequency at which the power spectrum of the detected noise signal has a zero; and,

summing results of the multiplying.

5. A method according to claim 4 wherein the function is a cosine function.

6. A method according to claim 5 wherein detecting each of the one or more magnetic signals comprises, for each of the one or more magnetic detectors, computing the complex value A given by:

$$A = \left[\sum_k S_k^m \cos\left(2\pi k f_q / f_s\right) - i \sum_k S_k^m \sin\left(2\pi k f_q / f_s\right) \right]$$

or a mathematical equivalent thereof where S_k^m is the k^{th} sample from an m^{th} one of the magnetic detectors; k is an index indicating the order of the samples in the sequence of samples from each of the magnetic detectors; f_q is a frequency of the magnetic signal; f_s is a frequency at which the samples are taken; and i is the square root of - 1.

7. A method according to claim 6 wherein the one or more magnetic signals have frequencies f_q which deviate from frequencies f_{qi} at which the power spectrum of the detected noise signal has zeroes

by a deviation amount and the method comprises performing a correction to the complex value $\boldsymbol{A}$.

8. A method according to claim 1 wherein the one or more magnetic emitters each comprises an electrically conductive coil connected to a source of an alternating electrical current.

9. A method according to claim 8 wherein the one or more magnetic emitters comprise at least three magnetic emitters.

10. A method according to claim 9 comprising operating each of the at least three magnetic emitters to generate a corresponding magnetic signal having a frequency distinct from frequencies of other ones of the magnetic emitters.

11. A method according to claim 9 wherein detecting the magnetic signals at six or more magnetic detectors comprises, for each of the at least three magnetic emitters, detecting the corresponding magnetic signal at each of a first set of magnetic detectors and the method comprises estimating a location of the magnetic emitter based upon relative amplitudes of the corresponding magnetic signal received at a subset of the first set of magnetic detectors which is different from a subset of detectors used for other ones of the at least three magnetic emitters.

12. A method according to claim 1 wherein determining relative amplitudes comprises using one of the magnetic detectors as a reference phase.

13. A method according to claim 12 wherein using one of the magnetic detectors as a reference phase comprises computing:

$$R_q^m = \mathrm{Re}\left(A_q^m \times \frac{\left|A_q^{m0}\right|}{A_q^{m0}} \right)$$

or a mathematical equivalent thereof wherein $\boldsymbol{R_q^m}$ is the relative amplitude of the signal from an $\boldsymbol{q^{th}}$ one of the magnetic emitters detected by a $\boldsymbol{m^{th}}$ one of the magnetic detectors; $\boldsymbol{A_q^m}$ is the complex amplitude of the signal from an $\boldsymbol{q^{th}}$ one of the magnetic emitters detected by a $\boldsymbol{m^{th}}$ one of the magnetic detectors; and $\boldsymbol{A_q^{m0}}$ is the complex amplitude of the signal from an $\boldsymbol{q^{th}}$ one of the magnetic emitters detected by a reference one of the magnetic detectors.

14. A method according to claim 1 wherein detecting the magnetic signals at six or more magnetic detectors comprises detecting the magnetic signals at each of a first set of magnetic detectors and the method comprises estimating a location of one of the magnetic emitters based upon relative amplitudes of the corresponding magnetic signal received at a subset of the first set of magnetic detectors.

15. A method according to claim 14 wherein the first set of magnetic detectors includes at least 60 magnetic detectors and the subset of

the first set of magnetic detectors includes not more than 50 magnetic detectors.

16. A method according to claim 14 wherein the first set of magnetic detectors includes at least 150 magnetic detectors and the subset of the first set of magnetic detectors includes not more than 50 magnetic detectors.

17. A method according to claim 14 comprising selecting at a first group of magnetic detectors for inclusion in the subset based on an indicator of a variation in the magnetic signal with position of the magnetic emitter.

18. A method according to claim 17 comprising selecting a second group of magnetic detectors for inclusion in the subset based upon a relative amplitude of the magnetic signal detected at the other magnetic detectors.

19. A method according to claim 14 comprising selecting a first group of the magnetic detectors for inclusion in the subset based on a first criterion and selecting a second group of the magnetic detectors for inclusion in the subset based on a second criterion distinct from the first criterion.

20. A method according to claim 19 wherein the first criterion selects for largest relative amplitude of the magnetic signal.

21. A method according to claim 20 wherein the second group selects for large variation in the magnetic signal with position of the magnetic emitter.

22. A method according to claim 21 wherein the first group is larger than the second group.

23. A method according to claim 14 wherein the subset includes 16 or fewer magnetic detectors.

24. A method according to claim 21 wherein the second criterion is based in part upon proximity to a reference magnetic detector.

25. A method according to claim 21 wherein the second criterion comprises selecting magnetic detectors having relatively large values of V given by:

$$V = \frac{|s_m - s_{\max}|}{|\vec{r}_m - \vec{r}_{\max}|}$$

or a substantial mathematical equivalent thereof where s_{max} is the amplitude of the signal at the magnetic detector having the largest signal from the magnetic emitter and $\vec{r}_{max}$ is the location of the magnetic detector having the largest signal from the magnetic emitter.

26. A method according to claim 7 wherein the one or more magnetic emitters comprise at least two magnetic emitters for generating at

least two magnetic signals having frequencies f_q which deviate from frequencies f_{qi} at which the power spectrum of the detected noise signal has zeroes by at least two deviation amounts, and wherein performing the correction comprises calculating at least two corrected amplitudes, each of the at least two corrected amplitudes comprising a sum of a correction function applied to the at least two relative amplitudes.

27. A method according to claim 1 wherein the one or more magnetic emitters comprise at least two magnetic emitters for generating at least two magnetic signals having frequencies f_q which deviate from frequencies f_{qi} at which the power spectrum of the detected noise signal has zeroes by at least two deviation amounts, and the method comprises correcting at least two relative amplitudes of the magnetic signals.

28. A method according to claim 27 wherein correcting the relative amplitudes of the magnetic signals comprises calculating at least two corrected amplitudes, each of the at least two corrected amplitudes comprising a sum of a correction function applied to the at least two relative amplitudes.

29. A method according to claim 28 wherein the correction function comprises a function of f_q and f_{qi}.

30. A method according to claim 29 wherein the correction function comprises a real correction function and an imaginary correction function.

31. A method according to claim 30 wherein the interval extends from *-T/2* to *T/2* and the real correction function comprises:

$$G_C(f_q, f_{qi}) = \frac{2}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} \cos\left(2\pi f_q t\right) e^{-i2\pi f_{qi} t}\,dt = \frac{\sin\left(\pi\left(f_q - f_{qi}\right)T\right)}{\pi\left(f_q - f_{qi}\right)T} + \frac{\sin\left(\pi\left(f_q + f_{qi}\right)T\right)}{\pi\left(f_q + f_{qi}\right)T}$$

and the imaginary correction function comprises:

$$G_S(f_q, f_{qi}) = -\frac{2i}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} \sin\left(2\pi f_q t\right) e^{-i2\pi f_{qi} t}\,dt = \frac{\sin\left(\pi\left(f_q - f_{qi}\right)T\right)}{\pi\left(f_q - f_{qi}\right)T} - \frac{\sin\left(\pi\left(f_q + f_{qi}\right)T\right)}{\pi\left(f_q + f_{qi}\right)T}$$

32. A method according to claim 31 wherein the at least two magnetic emitters comprise three magnetic emitters for generating frequencies $\boldsymbol{f_1}$, $\boldsymbol{f_2}$ and $\boldsymbol{f_3}$ which respectively deviate from frequencies $\boldsymbol{f_{1i}}$, $\boldsymbol{f_{2i}}$ and $\boldsymbol{f_{3i}}$ at which the power spectrum of the detected noise signal has zeroes by first, second and third deviation amounts, and wherein calculating the corrected amplitudes from the relative amplitudes is accomplished by matrix equations:

$$\begin{bmatrix} C_1 \\ C_2 \\ C_3 \end{bmatrix} = \begin{bmatrix} G_C(f_1, f_{1i}) & G_C(f_2, f_{1i}) & G_C(f_3, f_{1i}) \\ G_C(f_1, f_{2i}) & G_C(f_2, f_{2i}) & G_C(f_3, f_{2i}) \\ G_C(f_1, f_{3i}) & G_C(f_2, f_{3i}) & G_C(f_3, f_{3i}) \end{bmatrix} \times \begin{bmatrix} R_1 \\ R_2 \\ R_3 \end{bmatrix}$$

and

$$\begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix} = \begin{bmatrix} G_S(f_1, f_{1i}) & G_S(f_2, f_{1i}) & G_S(f_3, f_{1i}) \\ G_S(f_1, f_{2i}) & G_S(f_2, f_{2i}) & G_S(f_3, f_{2i}) \\ G_S(f_1, f_{3i}) & G_S(f_2, f_{3i}) & G_S(f_3, f_{3i}) \end{bmatrix} \times \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

where $\boldsymbol{R_1}$, $\boldsymbol{R_2}$, $\boldsymbol{R_3}$ and $\boldsymbol{I_1}$, $\boldsymbol{I_2}$, $\boldsymbol{I_3}$ respectively comprise real and imaginary parts of the relative amplitudes and $\boldsymbol{C_1}$, $\boldsymbol{C_2}$, $\boldsymbol{C_3}$ and $\boldsymbol{S_1}$, $\boldsymbol{S_2}$, $\boldsymbol{S_3}$ respectively comprise real and imaginary parts of the corrected amplitudes.

33. A method according to claim 28 where the integration time is an interval $t_0 \le t \le t_0 + T$ and the correction functions are:

$$G_C(f_q, f_{qi}) = \frac{2}{T}\int_{t_0}^{t_0+T} \cos(2\pi f_q t) e^{-i2\pi f_{qi} t}\, dt = G_C^R(f_q, f_{qi}) + G_C^I(f_q, f_{qi})$$

$$G_S(f_q, f_{qi}) = \frac{2i}{T}\int_{t_0}^{t_0+T} \sin(2\pi f_q t) e^{-2\pi f_{qi} t}\, dt = G_S^R(f_q, f_{qi}) + G_S^I(f_q, f_{qi})$$

and the matrix equation relating the real and imaginary amplitudes of the coil signals (R_p and I_p) to the real and imaginary signals measured at the ideal frequencies (C_p and S_p) is:

$$\begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ S_1 \\ S_2 \\ S_3 \end{bmatrix} = \begin{bmatrix} G_C^R(f_1,f_{1i}) & G_C^R(f_2,f_{1i}) & G_C^R(f_3,f_{1i}) & -G_S^I(f_1,f_{1i}) & -G_S^I(f_2,f_{1i}) & -G_S^I(f_3,f_{1i}) \\ G_C^R(f_1,f_{2i}) & G_C^R(f_2,f_{2i}) & G_C^R(f_3,f_{2i}) & -G_S^I(f_1,f_{2i}) & -G_S^I(f_2,f_{2i}) & -G_S^I(f_3,f_{2i}) \\ G_C^R(f_1,f_{3i}) & G_C^R(f_2,f_{3i}) & G_C^R(f_3,f_{3i}) & -G_S^I(f_1,f_{3i}) & -G_S^I(f_2,f_{3i}) & -G_S^I(f_3,f_{3i}) \\ G_C^I(f_1,f_{1i}) & G_C^I(f_2,f_{1i}) & G_C^I(f_3,f_{1i}) & G_S^R(f_1,f_{1i}) & G_S^R(f_2,f_{1i}) & G_S^R(f_3,f_{1i}) \\ G_C^I(f_1,f_{2i}) & G_C^I(f_2,f_{2i}) & G_C^I(f_3,f_{2i}) & G_S^R(f_1,f_{2i}) & G_S^R(f_2,f_{2i}) & G_S^R(f_3,f_{2i}) \\ G_C^I(f_1,f_{3i}) & G_C^I(f_2,f_{3i}) & G_C^I(f_3,f_{3i}) & G_S^R(f_1,f_{3i}) & G_S^R(f_2,f_{3i}) & G_S^R(f_3,f_{3i}) \end{bmatrix} \times \begin{bmatrix} R_1 \\ R_2 \\ R_3 \\ I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

34. A method according to claim 28 wherein calculating the corrected amplitude comprises using a 3x3 matrix of complex numbers.

35. A method according to claim 31 wherein calculating the corrected amplitudes comprises using a 3x3 matrix of complex numbers.

36. A method according to claim 1 comprising determining positions of the magnetic emitters from the relative amplitudes of the magnetic signals.

37. A method according to claim 36 comprising comparing the positions of the magnetic emitters to corresponding reference positions and triggering an alarm unless distances between the magnetic emitters and the corresponding reference positions are less than a threshold.

38. A method according to claim 36 comprising comparing the positions of the magnetic emitters to corresponding reference positions and generating a sensory feedback indicator based upon departures of the positions of the magnetic emitters from the corresponding reference positions.